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Northern Hemisphere temperature to precipitation relationships during the last Glacial from pollen records and climate simulations

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The hydrological response to radiative forcing is less understood than the thermal one: many climate models have difficulties in simulating seasonal rainfall and its variability. Indeed, future precipitation projections are much more uncertain than those of temperature. However, confident projections of precipitation are of crucial importance, particularly for highly populated regions where agriculture strongly relies on seasonal rainfall, such as South and Central Asia.

Instrumental data from Eurasia show a negative correlation between temperature and precipitation on short timescales (10^{-3} to 10^{0} years). However, on longer timescales (10^{1} to 10^{3} years), proxy data covering the Holocene show a positive correlation between temperature and precipitation. Climate models in contrast simulate a negative correlation on all timescales. To extend previous estimates to longer time scales, we focus on the last Glacial period, characterized by colder temperature than the Holocene as well as pronounced millennial-scale climate fluctuations in the Northern Hemisphere.

We reconstruct temperature and precipitation from four high resolution pollen records at mid-latitudes in the Northern Hemisphere. The estimates are compared with climate simulations. The chosen proxy sites cover the East and West coasts of both the Eurasian and North American continent. We employ four different statistical reconstruction methods to assess validity and biases of each method. The differences between reconstructed and simulated temperature-precipitation relationships as well as the zonal structure of orbital- and millennial-scale variations are examined. In particular, we explore the thermodynamic and dynamic contributions to the inferred relationships between temperature and precipitation.